

# Energy Tips – Steam

Steam Tip Sheet #9 • January 2006

Industrial Technologies Program



## Suggested Actions

- Review your blowdown practices to identify energy saving opportunities.
- Examine operating practices for boiler feedwater and blowdown rates developed by the American Society of Mechanical Engineers (ASME). Considerations include operating pressure, steam purity, and deposition control.
- Consider an automatic blowdown control system (see page 2).

## Resources

**U.S. Department of Energy**—DOE's software, the *Steam System Assessment Tool* and *Steam System Scoping Tool*, can help you evaluate and identify steam system improvements. In addition, refer to *Improving Steam System Performance: A Sourcebook for Industry* for more information on steam system efficiency opportunities.

Visit the BestPractices Web site at [www.eere.energy.gov/industry/bestpractices](http://www.eere.energy.gov/industry/bestpractices) to access these and many other industrial efficiency resources and information on training.

## Minimize Boiler Blowdown

Minimizing your blowdown rate can substantially reduce energy losses, as the temperature of the blown-down liquid is the same as that of the steam generated in the boiler. Minimizing blowdown will also reduce makeup water and chemical treatment costs.

As water evaporates in the boiler steam drum, solids present in the feedwater are left behind. The suspended solids form sludge or sediments in the boiler, which degrades heat transfer. Dissolved solids promote foaming and carryover of boiler water into the steam. To reduce the levels of suspended and total dissolved solids (TDS) to acceptable limits, water is periodically discharged or blown down from the boiler. Mud or bottom blowdown is usually a manual procedure done for a few seconds on intervals of several hours. It is designed to remove suspended solids that settle out of the boiler water and form a heavy sludge. Surface or skimming blowdown is designed to remove the dissolved solids that concentrate near the liquid surface. Surface blowdown is often a continuous process.

Insufficient blowdown may lead to carryover of boiler water into the steam, or the formation of deposits. Excessive blowdown will waste energy, water, and chemicals. The optimum blowdown rate is determined by various factors including the boiler type, operating pressure, water treatment, and quality of makeup water. Blowdown rates typically range from 4% to 8% of boiler feedwater flow rate, but can be as high as 10% when makeup water has a high solids content.

## Example

Assume that the installation of an automatic blowdown control system (see page 2) reduces your blowdown rate from 8% to 6%. This example assumes a continuously operating natural gas-fired, 150-psig, 100,000-pound-per-hour (lb/hr) steam boiler. Assume a makeup water temperature of 60°F, boiler efficiency of 80%, with fuel valued at \$8.00 per million Btu (\$8.00/MMBtu), and the total water, sewage, and treatment costs at \$0.004 per gallon. Calculate the total annual cost savings.

$$\begin{aligned}\text{Boiler Feedwater: Initial} &= \frac{100,000}{(1 - 0.08)} \\ &= 108,695 \text{ lb/hr}\end{aligned}$$

$$\begin{aligned}\text{Final} &= \frac{100,000}{(1 - 0.06)} \\ &= 106,383 \text{ lb/hr}\end{aligned}$$

$$\text{Makeup Water Savings} = 108,695 - 106,383 = 2,312 \text{ lb/hr}$$

$$\text{Enthalpy of Boiler Water} = 338.5 \text{ Btu/lb; for makeup water at } 60^\circ\text{F} = 28 \text{ Btu/lb}$$

$$\text{Thermal Energy Savings} = 338.5 - 28 = 310.5 \text{ Btu/lb}$$

$$\begin{aligned}\text{Annual Fuel Savings} &= 2,312 \text{ lb/hr} \times 8,760 \text{ hr/year} \times 310.5 \text{ Btu/lb} \times \$8.00/\text{MMBtu} \\ &\quad / (0.80 \times 10^6 \text{ Btu/MMBtu}) \\ &= \$62,886\end{aligned}$$



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$$\begin{aligned}\text{Annual Water and Chemical Savings} &= \frac{2,312 \text{ lb/hr} \times 8,760 \text{ hrs/yr} \times \$0.004/\text{gal}}{8.34 \text{ lb/gal}} \\ &= \$9,714\end{aligned}$$

$$\begin{aligned}\text{Annual Cost Savings} &= \$62,886 + \$9,714 \\ &= \$72,600\end{aligned}$$

## Automatic Blowdown Control Systems

These systems optimize surface blowdown by regulating water volume discharged in relation to amount of dissolved solids present. Conductivity, TDS, silica or chlorides concentrations, and/or alkalinity are reliable indicators of salts and other contaminants dissolved in boiler water. A probe provides feedback to a controller driving a modulating blowdown valve. An alternative is proportional control — with the blowdown rate set proportional to the makeup water flow.

## Cycles of Concentration

“Cycles of concentration” refers to the accumulation of impurities in the boiler water. If the boiler water contains 10 times the level of impurities in the makeup water, it is said to have 10 cycles of concentration.

## References

1. “Consensus Operating Practices for Control of Feedwater/Boiler Water Chemistry in Modern Industrial Boilers,” published by the ASME, 1994.
2. “Recommended Rules for the Care and Operation of Heating Boilers,” Section VI of the ASME Boiler and Pressure Vessel Code, 1995.
3. “Recommended Guidelines for the Care of Power Boilers,” Section VII of the ASME Boiler and Pressure Vessel Code, 1995.

*Adapted from an Energy TIPS fact sheet that was originally published by the Industrial Energy Extension Service of Georgia Tech.*

BestPractices is part of the Industrial Technologies Program Industries of the Future strategy, which helps the country's most energy-intensive industries improve their competitiveness. BestPractices brings together emerging technologies and best energy-management practices to help companies begin improving energy efficiency, environmental performance, and productivity right now.

BestPractices emphasizes plant systems, where significant efficiency improvements and savings can be achieved. Industry gains easy access to near-term and long-term solutions for improving the performance of motor, steam, compressed air, and process heating systems. In addition, the Industrial Assessment Centers provide comprehensive industrial energy evaluations to small- and medium-size manufacturers.

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